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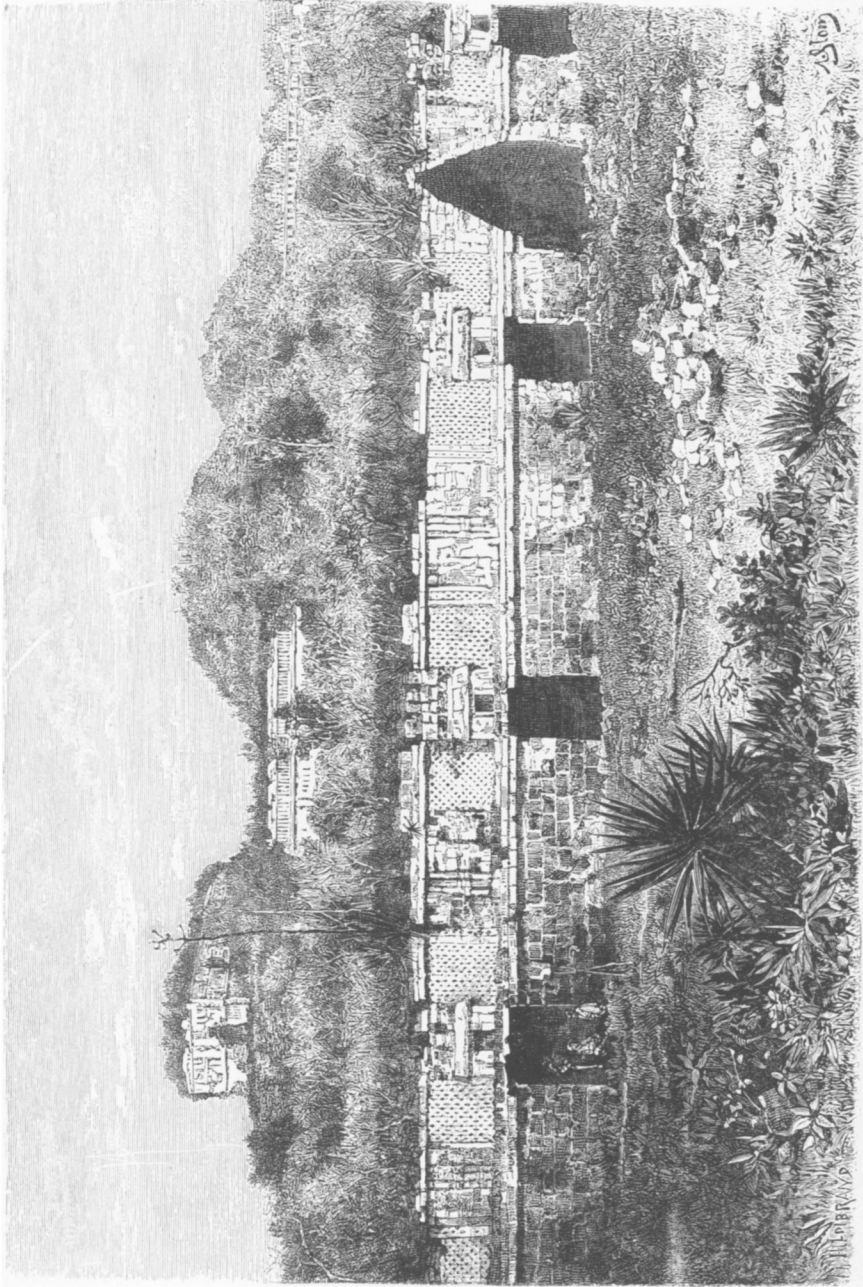
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RUINS OF UXMAL, YUCATAN.
From "Les Anciennes Villes du Nouveau Monde."

BULLETIN
OF THE
AMERICAN GEOGRAPHICAL SOCIETY

Vol. XX

1888

No. 1

ANNUAL ADDRESS

OF

CHAS. P. DALY, LL.D., PRESIDENT.

RECENT GEOGRAPHICAL WORK OF THE WORLD.

INTRODUCTION.

When I began, many years ago, to give, in an annual address, an account of the geographical work of the world, what was then done was so small, and the information to be obtained respecting it within a year was so limited, that I had to fill out my address with some other geographical subject.

In the course of time, however, the field of exploration became so great, and the amount of information to be obtained within a year so extensive, that I found it difficult to compress an adequate account of it within the narrow limits of such an address.

Minor details could be omitted when there was such geographical information to impart as was supplied by the Russian invasion of Eastern Asia, which made us acquainted with those long inaccessible cities of Bok-

hara and Samarcand, and those wild and conquering races that in the 12th and 14th centuries swept over Asia under Genghis Khan and Timour the Great, or where there was such a geographical event to describe as that wonderful descent of Stanley down the Congo, which revealed the course of that river and opened up Central Africa.

But such material is not to be found every year. There is a large amount of geographical work constantly going on ; and however wide-spread and important it may be, the details of it are so very much alike that a complete enumeration of them would make such an address exceedingly monotonous. For this reason I have, for a few years past, devoted my address to other subjects ; but in that interval so much has been done that is important and interesting, that I return with pleasure to a duty I discharged for so many years.

UNITED STATES.

I shall begin with an account of what has been done in our own country.

EXPLORATIONS IN ALASKA.

An expedition under Mr. W. H. Dall, so well known for his previous scientific researches in Alaska and the Aleutian Islands, established forty-two stations in Alaska for magnetic and astronomical observations, and settled the boundary line between the Russian and the American possessions, which line, as settled, passes through the Diomedé Islands, in Behring Strait.

One of the remarkable discoveries was made in Kotzebue Sound. A mountain of ice from 600 to 800 feet

high, at a little distance inland, extended to Point Barrow. This great sheet of ice was covered with a non-conducting layer of moss and of vegetable mould, the clay of the period when the wild horse, the buffalo and the mammoth ranged over it; the bones of all of which animals were there found.

Lieut. Schwatka made a remarkable exploration of the Yukon River, in Alaska. He crossed with his party the Coast Range of Alaska to the head waters of the river, and there constructed a raft with which he boldly made the descent of this hitherto unknown stream for 1,500 miles—the longest voyage of this description ever made upon a raft. He surveyed the whole length of the river, which is more than 2,000 miles long, returning by sea to San Francisco.

A second expedition under the command of Schwatka was sent to Alaska in 1886 by the proprietors of the *New York Times*. The special object of this enterprise was the exploration of the Mt. St. Elias region. The results were the discovery of a river flowing from the base of the great mountain into Icy Bay. To this river was given the name of Jones, in honor of the patron of the expedition. It is claimed that this was not a discovery, and that the river was previously known. I shall not in this address enter into the dispute, but leave the river with the name that has been given to it. Several glaciers of great magnitude were also explored and named. An attempt was made to ascend the volcano; but, after reaching a height of 7,200 feet, the party found the obstacles insurmountable.

Another great river in Alaska was discovered and partly explored by Lieut. Stoney. It has been called

the Putnam, and empties into the Arctic Ocean, from which Lieut. Stoney entered it. For 300 miles from its mouth the stream was found to be broad and deep, and received many tributaries. After that distance Lieut. Stoney's further course was impeded by rapids. An attempt for seven days to haul their boats further up the river wore out his men, but the lieutenant, with two companions, made his way farther up, and found the river about the same as it was below the rapids.

Alaska appears to be as rich in glaciers as Switzerland. Mr. F. S. Wright has recently examined and described the most remarkable and the largest glacier yet discovered in the North-west. It is in Muir Inlet, from which it has been named. It is 250 feet high, and fills an amphitheatre more than 30 miles wide and of about the same breadth.

ARCTIC.

It will be sufficient, as I am in the region of the Arctic, simply to mention the Greely expedition and the rescue of its commander and survivors, for the Society gave General Greely and his companions a public reception, and is fully acquainted with the particulars of the expedition and its results.

The other Arctic expedition sent out at the same time under Lieut. Ray, to establish a Meteorological Station at Point Barrow, was more fortunate. A series of valuable observations was made ; among others that there is no warm current running in this direction into the Arctic, and nothing to indicate the existence of an open Polar sea.

Geographical discoveries of importance were made by

Dr. Boas, a member of our society, in Baffin Land in 1883-1885. Dr. Boas rectified the line of the coast from Exeter Sound to the north, and the northern and eastern coasts of Cumberland Sound. He laid down correctly many of the islands, and devoted himself to a careful ethnological study of the Eskimos.

The suggestion made some years ago by Nordenskjöld that the interior of Greenland might be found upon investigation to be less desolate than was generally supposed, has not been confirmed by the results of recent explorations. Nordenskjöld himself in 1883 penetrated the country to a distance of 87 miles, and sent the Lapps of his party 143 miles farther, without finding any break in the great mass of snow and ice, which rose as the explorers advanced until it reached a height of 7000 feet.

Lieut. Peary, three years later, made a reconnoissance which confirmed Nordenskjöld's experience even more strongly, for he mounted 500 feet higher on the ice-cap than the Swedish explorer.

The effort to utilize Hudson Bay as a commercial highway to the north-west territory of the Dominion of Canada has not been successful. The result that has been found is that the passage through the 400 miles of Hudson Strait is never a safe one, even during the two or three months of the year when it is supposed to be open, and that a change in the wind may at any moment block it up with impenetrable ice.

COAST SURVEY.

A large amount of important geographical work has been done by the Coast Survey, which involves too

many details to be embodied in this address. A full account of it, for which I am indebted to the politeness of the superintendent, F. M. Thorn, Esq., will be published in connection with the Address in our Journal.

ANTIQUITY OF MAN IN AMERICA.

It has long been settled that North America, geologically, is the oldest of the continents. It has of late years been claimed by many American geologists that it was the first inhabited, or, at least, that the earliest remains of man have been found here. As all previous investigation by ethnologists, archæologists and historians has indicated that the earliest home of the human race was in the vicinity of the table-land of Central Asia, or in Asia Minor, this conclusion on the part of American geologists was not generally accepted, or, rather, to express it more correctly, was not thought worthy even of serious consideration. A very high authority, Mr. Alfred R. Wallace, who shares the honor of having announced contemporaneously with Darwin the discovery of the Darwinian theory of evolution, has carefully examined all the evidence relied upon by American geologists, and after a full and well-arranged statement of it, shows conclusively that man existed upon the American continent not only throughout the glacial period, when the northern part of America was covered by a great sheet of ice, but that he existed before it, in that period known to geologists as the Pliocene. It is now time, Mr. Wallace says, that the extreme scepticism that has existed on this subject should give way to an ever-increasing accumulation of facts. He especially dwells upon the fact that the Calaveras skull was

found in 1866, beneath four beds of lava, with a fifth bed of gravel on the surface, and upon the fragment of a human skull with the debris of a mastodon, that was taken out in 1857 from a shaft in Table Mountain in California, 180 feet below the surface; these fragments lying beneath a bed 3 feet thick of cement, together with fossil leaves and branches, over which were 70 feet of clay and gravel.

We have therefore the curious fact that what has been called The New World (America) is, geologically, the oldest, and was, as far as existing evidence shows, the earliest abode of the human race.

ANCIENT NORTH AMERICAN CITIES.

Mr. F. Cushing, who two years ago gave the Society an interesting account of Zuñi Land and its ruined cities and Pueblos, is at present at the head of the Hemenway expedition, which for several months has been engaged in excavating the ruins of an ancient city in Arizona, which is 3 miles long and 2 miles wide. He had previously found three other cities which constitute a part of a chain of cities that once covered what is now a desert. There are nineteen of these ruined cities in Salt River Valley alone, one of the smallest of which must have had a population of at least 10,000 persons. The people who lived in these cities, it is said, preceded the Aztecs, and had, to judge from the human remains and relics that have been found in the houses, a civilization which the explorers think as old or even older than the Egyptian Pyramids. Mr. Cushing says that the dwellers in these plains were Toltecs, an agricultural people, who had reached a high state of civilization

many centuries before the Aztecs appeared ; that they were of Asiatic origin, but not a Mongolian race like the Indians of the Pacific coast, who were, he thinks, a later emigration. The soil and climate seem to have been the same as now, but a vast system of irrigation was required to make the land productive, for which ditches were dug. There were traced and laid out on the maps of the expedition, 300 miles of these ditches.

The population of one of the plains—that of Tempe, which had been highly cultivated, is estimated to have been 250,000. But this is only one place ; similar indications of these ruined cities were found over adjoining mountains and through three successive valleys.

The chief food of the people was corn, which was very abundant. Their animal food was of the deer, the antelope and the rabbit ; the remains of no other animal having been found. They had neither horses nor sheep. In the mountains the buildings were of stone instead of *adobe*, and the fields were divided by stone walls. Mr. Cushing thought these ruins extended as far as Utah and Southern Colorado, and as far east as the Rio Grande, and into Central Mexico. In the large city—“De los Muertos”—or the city of the dead, twenty-two large blocks of buildings have been explored, and three railroad car loads of relics taken from them have been sent to Boston. One of the buildings measured 400 by 375 feet. The buildings are two stories high, the entrance in some being through door-ways and in others through the roof. The roofs were of concrete, and most of them have fallen outward, indicating destruction by earthquakes ; and that the cities were suddenly overthrown by a convulsion of this nature, appears by the

finding of skeletons under fallen roofs and timbers, in a position to indicate a sudden and violent death, and the large number of skeletons found shows that the destruction was sudden and wide-spread. The people that remained after these fields and cities were destroyed were made war upon by the wild tribes of the hills and forests. They were driven south into Mexico and beyond it, until every vestige, except these ruins of this remarkable and widely-spread pre-historic civilization passed away forever.

CENTRAL AMERICA.

CHARNAV'S EXPLORATION OF ANCIENT CITIES IN MEXICO,
GUATEMALA AND YUCATAN.

M. Désiré Charnay, whose name is well known to the Society, resumed his exploration of the ruins of the ancient cities scattered through Mexico, Guatemala and Yucatan, and has embodied the result of his labors in a sumptuous volume, the interest of which is heightened by the manner in which the journey of the traveller is interwoven with the exploration and learned expositions of the archæologist; a book distinguished by the newness of the facts, the comprehensive grasp of the subject, and the charming style in which the narrative is written.

He describes a civilization, he says, long extinct, though not very old, and unknown, or rather misunderstood. He traces its origin on the high plateaux of Mexico to its highest development as it moved southward in the different parts of Central America; a civilization beginning with the Nahuas, a people of several tribes, of

which the Toltecs was the most endowed, a race intermingled with many foreign elements, people of the Antilles, Polynesians, Japanese, Chinese, Cochin Chinese, and Malays. He fixes this civilization as existing from the 7th to the 14th century. He thinks that the people from whom it emanated entered America by Behring Strait, after traversing Tartary, crossing the ocean on square rafts and large flat boats, called in the manuscripts sea houses, and then moving southward, founding their first city not very far from the present City of Mexico, and their second and more famous city near the north of the Gulf of California. He thinks that he has been able to fix the date of certain epochs and to establish some historical truths. He pays a high compliment to our countryman, Stephens, who preceded him in the exploration of Yucatan.

He believes that this civilization was mainly Toltec; that the Toltecs were the inventors of the hieroglyphics or written language by which they preserved their history on skins of animals, or on paper made of the maguey or palm tree, and were the inventors of many arts they are known to have possessed; that they were the great builders; and he finds an extraordinary resemblance between the sculptures at Angkor, in Cambodia, and the temple of Castillo, at Chichen-Itza, in Yucatan. The account he gives us of this people and of their great city, Tula, is most interesting; their pure manners, high morals, poetical feeling, and religious conception of a future life. He tells us that their principal god, Tlaloc, the god of rain and abundance, was a beneficent being, and worshipped by offerings of flowers and fruit; and that it was their successors who changed his worship into a

bloody sacrifice, instead of the gentle and poetical rites of this highly civilized and interesting people.

SOUTH AMERICA.

The French explorer, Dr. Crevaux, after geographical labor in the affluents of the Amazon and in Guiana, explored the Guaviare, a branch of the Orinoco, and descended the Orinoco to its mouth, where he passed some time studying the Indian tribes. In 1882 he went on an expedition to the Gran Chaco, where he and his party were massacred, near the mouth of the Pilcomayo, by the Toba Indians. M. Thouar organized an expedition to relieve the survivors, if there were any. He entered the Gran Chaco in the N. of the Argentine Republic, in the autumn of 1883, and reaching the spot where the massacre occurred, he found that the whole party had perished, and his own company was only saved from destruction by incessant vigilance. After several months of great hardship he reached Asuncion by way of the Pilcomayo River.

M. Wiener, the French Vice-Consul in Ecuador, passed through the Napo River to the Amazon, and so reached Brazil.

In 1885 M. Thouar was sent to study the Pilcomayo River, particularly with a view to its fitness as a waterway for commerce, and his report is that the river, with little trouble, could be made navigable.

The Gran Chaco he declares to be a healthy and fertile country, naturally divided into three zones: (1) that of the lowlands, near the streams; (2) that of a higher level, subject to overflow in great freshets, and (3) back of these the elevated plains, which are never submerged

by floods. The Pilcomayo banks are higher than the country behind them.

A most notable exploration in Brazil was that of the Xingú River by the German explorers Von Steinen and Claus. They started from Cuyabá, the chief town of Matto Grosso, a province more than four times as large as California, and descended the river to the estuary of the Amazon. Their observations established beyond a doubt that the whole of Brazil, south of the Amazon Valley, was once a great table-land, which has been undergoing denudation by water. The Matto Grosso region is of sandstone formation, with a mean elevation above the sea of 1475 feet. The chief commercial product of the Xingú is india-rubber.

The sources of the Orinoco, it is reported, have been reached within the past year by M. Chaffanjon. Some doubt still remains as to the fact, but it is certain that the mystery which has covered the origin of this mighty river will soon be dispelled.

The exploration of the southern end of the South American continent has been mainly the work of the Argentine Government. Mr. Moreno, under commission from his government, ascended the Rio Negro in Patagonia, and penetrated as far as the eastern slope of the Andes and the great lake, Nahuel-Huapi, which lies in the midst of mountains clad with birch and pine trees and abounding in glaciers. A later expedition established the fact that the waters of Lake PiriHuacá, which pass to the Pacific through the river Calle-Calle, have also an outlet to the Atlantic through the river Huahun.

Lieut.-Col. Fontana, Governor of the Chubut River territory, explored, in 1885 and 1886, the plains and the

slopes of the Andes. The aspect of the open country was desolate, but all the valleys were found to be covered with a rich vegetation. There were innumerable lakes, and streams of clear water, which were always in sight.

The French scientific expedition sent to Tierra del Fuego, in 1882, to observe the passage of Venus, made a number of hydrographical surveys and soundings in the archipelago.

A very interesting and valuable report upon Tierra del Fuego has been sent this year to the United States Government, by our Consul at Buenos Ayres, Mr. E. L. Baker, which shows that the general impression hitherto received respecting this region is unfounded; that it is a far better country than it has been represented, and is, especially the Argentine portion of it, largely capable of colonization and settlement. No country, says Mr. Baker, has ever been so persistently maligned and misrepresented, because those who visited its coast never penetrated into the interior, but drew their conclusions from what they saw or imagined they saw from their ships. Mr. Ramon Lista, who has travelled extensively in South America, and explored nearly all of Patagonia, says in respect to this part of Tierra del Fuego: "I have travelled from one extremity of the country to the other, and am scarcely able to credit what my astonished eyes have seen." Instead of the cold, bleak, and inhospitable country that it has been represented, he saw flowery plains of grasses capable of sustaining thousands of cattle and sheep, leagues upon leagues of rich valleys, accessible mountains, without snow, magnificent fruits, plants that in Buenos Ayres can be

grown only in a green-house, and nowhere had he received such profound emotions in the contemplation of natural scenery as in Tierra del Fuego. This statement, with what he says of the mildness of the climate, of its grassy valleys, rich pastures and virgin prairies, is indeed, geographically, a revelation.

AFRICA.

For the past few years Africa has been the part of the globe in which geographical exploration has been the most extensive and the most important. Beginning with the northern coast, a material fact to notice is the extension, in 1882, of a French protectorate over Tunis, which is, in fact, substantially taking possession of the country. Lieut.-Colonel Playfair, the British Consul General, who, in 1876, was the first person to pass through the Khoomir country, which was then a blank upon the maps, in 1884, eight years afterwards, visited the same region, passing over admirable carriage-roads, which were the work of the French. There is now a railway from Suk-Ahras, on the Algerian frontier, to Tunis, in which city good roads have been made and a new French city, alongside of the old one, is now springing up. Land is rapidly purchased for cultivation under the Torrens Act, by which it is said real property is as easily transferred as a bank share. The Roman remains throughout Tunis are being explored more effectually than has heretofore been done respecting remains of Roman civilization in Northern Africa.

In the years 1883 and 1884 Mr. de Foucaud made an extensive journey in Northern Africa. He traversed the Atlas range, passing along its whole length to the

Algerian frontier, a distance of 435 miles. Although the Atlas Mountains have been long known, they have never been fully explored, for he found the range flanked by parallel ranges that are not on any map. There is a chain 186 miles long, which lies north of the Atlas range, and south of it are the little Atlas and the Djebel-Bani ranges.

The Sahara Desert has recently been more accurately ascertained by a number of explorers. The mean elevation of this region is now known to be 1600 to 1650 feet above the level of the sea. A fifth part of it only has been found to be sandy, and chains of mountains, unknown before, have been discovered that are from 6000 to 8000 feet high. In some parts of it there is a rainy season, when the thermometer ranges from 122 Fah. to 19 degrees, and where the loftiest mountains are capped with ice for several months in the year, whilst in other portions of the Sahara rain falls only once in about 20 years. The whole area of this great region is now ascertained to be 3,700,000 square miles, which is about the size of the whole of Europe. Its entire population is now estimated at about 3,000,000, and there are towns containing from 5000 to 10,000 inhabitants, which is a much more favorable condition than has been supposed, as this whole space has hitherto been marked upon the maps as one vast desert.

The region between the rivers Senegal and the Niger for nearly 1000 miles in length has been surveyed, and the water-shed of the Senegal has been found to be near Bamaku, on the Niger, and all the rivers descending from it flow into the Senegal.

In 1887 the French commander in that region, Cap-

tain Gallieni, sent up the river Senegal a steamboat in parts, which was carried across the water-shed from the Senegal to Bamaku upon the Niger, where the boat was put together, and from there she went under the command of Lieut. Caron, up the Niger north to Kábara, which is the port of Timbuctoo. The unexpected appearance of this boat, moving without oars or sails, for a steamboat had never been there before, as the rapids and other obstructions on the Niger prevent the passage of vessels from the gulf, filled the people of Timbuctoo with amazement, none of whom had ever seen a steamboat, and few of them had ever heard of one.

This city was last visited in an overland journey across Morocco by the Austrian traveller, Dr. Lenz. He found it somewhat larger than it had been described by Barth, the German traveller, in 1854, but even now it is not remarkable in population, as it has but about 20,000 inhabitants. It will be remembered that the wealthy Dutch lady, Miss Tinne, who became distinguished as a geographical explorer in Borneo and in Africa, was killed near this city. Dr. Lenz saw one of the party by whom she was murdered. He was also told that some of the effects of Col. Laing, who had been killed in this part of Africa more than 50 years ago, were still preserved. Col. Gallieni has reported that the country of the upper Gambia and its affluents has now been surveyed, and that, by a treaty made with the Almamy Samory, a French protectorate has been extended along the right bank of the Niger from Segu to the boundaries of Liberia and Sierra Leone.

The sources of the Niger were discovered in 1879 by the French explorers Zweifel and Moustier, in the hills

near Nelia, about 200 miles east of Freetown, the capital of Sierra Leone. The course of this great river is north-north-east, to Timbuctoo, when it turns to the east, then to the south, south-east, and finally south to its mouth in the Gulf of Guinea. The country enclosed between the river and the gulf is almost wholly unknown.

Germany, as will more fully appear hereafter, has become a great colonizing power in Africa. She has annexed in part what is known as the Cameroon region, on the west coast; and through her possessions on the Gulf of Guinea she is now reaching inward for the trade of the Soudan and the country about Lake Tchad.

The Cameroon region has considerable elevation at a short distance from the sea. The chain known as the Cameroon Mountains reaches to an altitude of more than 10,000 feet. At the height of 3,000 feet the palm tree ceases and is succeeded by tree ferns, until at 8,000 feet the wood belt ceases altogether. At the height of 12,000 feet on the Cameroon Peak, Mr. Grenfell, the English missionary, found that the thermometer marked in the month of March 47° Fah. The country is in most places exceedingly fertile and is capable of great development, to which those native organizations known as Secret Societies are strongly opposed; and as the influence of these Societies over the chiefs and kings is very great, they may interpose serious obstacles to the development of this part of Africa.

It is very evident that the creation of the Congo Free State, which dates only from 1885, and embraces a great portion of the valley of that river, has been an

important factor in the civilization of Africa, as it has undoubtedly stimulated the Portuguese and other powers having African territory to greater exertions. It has roused the colonizing instinct in nations hitherto indifferent to efforts of that kind. Germany has already withdrawn the large fund which was annually devoted to geographical exploration, that it might be applied exclusively towards the successful colonization of the portions of Africa of which she has taken possession.

What has been done in the region of the Congo in three years is wonderful. The river has been carefully traced from Lake Tanganyika, in the east, and along its northern curve to the Equator, and thence south-west-erly, until it discharges itself into the Atlantic. The greater part of the valley of this great river, with its subordinate valleys of the Ubangi on the north and the Kassai on the south, is full of streams and capable of extensive cultivation. Along the river many stations have been founded, which are likely to grow into extensive centres of civilization, and the activity of explorers, English, French, German, Swedish, and Austrian, has been unremitting.

An English engineer, who has furnished a very valuable paper in a recent number of *Blackwood's Magazine*, confirms the statement of Stanley that the country in the interior is far healthier than the coast, and that with ordinary care it is not more injurious than the climate of the island of Jamaica or of Singapore.

The climate, he says, is blamed for fevers and other diseases which are brought on by the follies and carelessness of the new-comers, and that the fevers of the country are not dangerous if treated in time, and can

generally be avoided by care. When the country, he says, is more opened up, and Europeans are able to bring out home comforts, they will be able to live there with as much ease and safety as they now do in India.

The effort of the King of the Belgians in maintaining the organization and the keeping up of a central route as a means of communication from the west to the east coast, has added greatly to our information of the extensive region through which the Congo flows. Steamers now run on the upper Congo from Stanley Pool to Yellala Falls, where the lower Congo begins. For 230 miles this great river is unavailable for the purposes of navigation. Over this long distance merchandise has to be carried by porters, marching in Indian file through a pathway about 9 inches wide, bounded on either side by a dense jungle of cane-like grass, which is never lower than the shoulder. Over this unavailable space for navigation a railway is now contemplated, and when this is accomplished a great change in the whole of Central Africa will follow.

Lieut. Wissman has made a second journey across Africa. He started in October, 1886, from Luluaburg, a station of the Congo Association, in the empire of the Muata Yambo. He had wished to explore the country to the north-east of the Lubi River, but he found the state of things so much changed since his former visit, four years ago, that he was unable to carry out his project. Formerly the cowrie was the principal object of barter, but now guns and ammunition were what was demanded. The slave trade was flourishing on the Lukassi River. He was attacked and several of his party were killed by poisoned arrows. The land of the

industrious Beneki, whom he visited on his first journey. he found entirely devastated. He crossed a country depopulated by war and by small-pox. His own followers were stricken by the disease, and the party suffered for want of food. When he reached Nyangwe he found the Arabs in great excitement over the capture of Stanley Falls Station. From there he sent back the Bassilonge who were with him, and continued on his route to Zanzibar, whence he returned to Europe.

The results of this expedition are not so important as it was hoped they would be. What was wanted was a more thorough knowledge of the hydrography of Central Africa, to which the expedition, for the causes above stated, can have contributed but little.

The Kalahari desert of Southern Africa is by no means an uninhabited waste. The estimate of its size varies from an area equal to that of Texas to one of twice that extent. The Orange River forms its southern boundary, and it is partly watered by eight or ten rivers on the east, and by Lake Ngami. The small streams which feed these rivers, overflowing in certain places, create marshes; but the land is generally elevated, the central water-shed being over 4000 feet in height at a point where Mr. A. A. Anderson, who has studied the desert for many years, ceased his explorations.

Coming to the east coast of Africa, the first fact to be noticed is the signal success on the part of the Portuguese in Mozambique, a colony that for more than forty years has been harassed by the depredations of a chief named Bonga, who controlled the Zambesi between Tete and the sea. The stronghold of this robber chief and

all of his fortified villages were captured recently and his mastery over a river so important as the Zambesi has now wholly ceased.

The Congo Free State has made no effort to extend its authority between Lake Tanganyika and the Indian Ocean, for Germany has practically annexed, under the name of a protectorate, the whole of the territory, of undefined extent, but which is estimated at 150,000 square miles, lying between Lake Tanganyika and the main land of the Sultanate of Zanzibar, which embraces Dar-es-Salam, one of the finest harbors on the Indian Ocean. Stations have been already established on the roads leading inland to Massai Land and around Mount Kilimanjaro, the highest mountain in Africa. This great mountain, which lies about three degrees below the equator, in the range of mountains that stretch from the Victoria Nyanza to the ocean, is 20,000 feet in height. It was first discovered by the missionary, Rebman, nearly forty years ago. It has since been visited by many travellers who have attempted unsuccessfully to climb it; but Dr. Meyer, it appears from recent information, succeeded in attaining to within 200 feet of the top of Kibo, the higher of the two peaks.

Like many of the Mexican and South American mountains, Kilimanjaro presents every variety of climate and nearly every form of vegetation, from the plants of the Torrid Zone to those of the Arctic.

Farther to the south and west the new German territory is bounded by Lakes Tanganyika and Nyassa, and in this way the colony will have an outlet into the great basins of the Nile, the Congo and the Zambesi. The whole region is remarkably fertile, so far as known. The

climate is favorable to the white man, and it is a subject of general congratulation that the development of this large and important region of Africa has passed into the hands of the Germans.

Immediately north of this German Protectorate lies a somewhat smaller protectorate, which is recognized as English, and which has heretofore been as little known as Kilimanjaro.

The line claimed by the English runs north-west to the Victoria Nyanza, and across the mountain range. Almost under the equator stands Kenya, the second in height of the African peaks. The mountain, as seen and described by Mr. Joseph Thompson, appears to be more impressive even than Kilimanjaro. Mr. Thompson says Kenya rises as a great volcanic cone, nearly 30 miles in diameter at its base, from an elevated, thorn-clad plain, 5700 feet above the sea, to an altitude of 15,000 feet. He says the angle of the mountain is very low with a slope comparatively unbroken by ridge or glen. From that height of 15,000 feet the mountain suddenly springs up 3000 feet in a sugar-loaf peak, the resemblance to a sugar-loaf being made the more striking by the glittering facets of snow which characterize this peak.

Just north of the English Protectorate lies Vitu, a German colony, at the lower limit of the vast region known as Somali Land, a land which stretches north-east to Cape Guardafui, and thence west to the Gulf of Tanjarah. The limits of the interior of Somali Land are somewhat undefined, but it would seem to be as large as France. It is inhabited by the Somali and Galla races, which are divided into many tribes, who are so war-

like that they are not often at peace among themselves, and so aggressive to strangers as to make the exploration of Somali Land exceedingly dangerous. The Gallas, living more to the west, have crossed into Abyssinia and established themselves there. Not only are the tribes hostile to strangers, but the country itself is difficult of access. A journey from Zeila, on the Gulf of Aden, to the Harar, a distance of 185 miles, gives a very good idea of the general nature of this land. The first 50 miles is over a sandy plain, without water, after which the road is up the beds of rivers, across mountains and through deep ravines. Here are vast tracts of stony plains, supposed to be impassable, and from the warlike character of the savages who inhabit this region, and the nature of the country itself, it may be a long time before we shall have anything more than a fragmentary knowledge of this great peninsula.

The exploration of the interior has been actively undertaken by Italian travellers, of whose explorations and journeys I have given an account in previous addresses. The efforts of these Italian explorers may be briefly summed up in the short statement that they have displayed the highest heroism, with the most devoted perseverance, and have added many to the long list of those who have succumbed to disease or lost their lives by violence, in the effort to penetrate and civilize this vast continent.

In Egypt, now under British control, the labors of travel and exploration have been confined to the better known portions of the country, and have been necessarily archæological in their character.

During the past year, however, Prof. Ascherson made

some investigations in the Delta of the Nile, east of the Rosetta branch. He visited the coast lake, Burlus, which he calls Brullus. It abounds in salt-water fish, and the district contains 100 settlements and about 15,000 people. The town Burlus, marked on the maps, does not exist, and the cartography of the district was found to be in need of correction.

Prof. Ascherson then proceeded to the Suez Canal and followed the Syrian caravan route to El-Arish. The country east of the canal is rich in vegetation, and the rain-fall in winter is not inconsiderable. There were heavy showers on April 30th and May 1st, which is noticeable, as Egypt is supposed to be rainless. Fair hair and blue eyes were not uncommon among the inhabitants, who were a mixture of Arabs, Syrians and Turks.

The Raïan basin of the Nile, explored and surveyed by Cope Whitehouse, is found to be adapted to the formation of a storage reservoir for the waters of the Nile; and the English engineers strongly urge the undertaking of an enterprise for the purpose.

Both Emin Pasha's geographical work in the Egyptian provinces, and the Congo Free State, are but the realization of Gordon's idea that the civilization of Africa could only be worked out by attacking and suppressing the slave trade from within as well as from without.

The possession of the sea-coast by the European Powers will cut off the foreign market for slaves, and it is hoped put an end to this traffic, which is now desolating the healthy regions of the interior, for on its suppression depends the future civilization of Central Africa.

EARTHQUAKES AND VOLCANIC ERUPTIONS.

The changes made upon the earth's surface by the effects of earthquakes and volcanoes may be embraced in this enquiry, as they are a part of the geographical work of nature. As the disturbance of the earth's surface by earthquake-shocks and the breaking forth of subterranean forces in volcanoes have, during the period covered by this address, been so extensive and so widespread, a very brief enumeration of them may be offered to show how much takes place in this way in a very limited space of time.

In 1880 there were thirty earthquakes, and in 1881, twenty, the most serious of which was at Casamicciola, upon the island of Ischia, in the Bay of Naples, which destroyed the upper end of the town : by which one hundred persons were killed. This is supposed to have been caused by the sinking of the soil.

In 1882 there were fourteen earthquakes in Europe, Asia and America, and seventy-four in Japan, where Professor Milne says there is an earthquake every day in the year. There was a severe one that year at Fayal, in the Azore Islands, and a severe one at Panama. In 1883 many shocks were felt in Andalusia and Murcia, in Spain, and along the Mediterranean to the Balkan region. In 1884 there was one in England, with great damage to buildings and some loss of life. Thirty-four slight ones were reported that year from various places, thirty of which were in Japan. Upon Christmas night of that year violent shocks were felt in Austria, in Italy, and especially in Southern Spain. At Arenas del Rey 500 persons were killed or injured, and others in many towns along the coast. At Alhama, the upper town,

which was on a hill, was thrown upon the lower town, and 1500 houses were crushed. The area chiefly affected was between Cadiz and Cape Gata, and from Malaga to the Carpetana chain. At Güevejar a fissure opened in the earth which split an olive tree in the centre from root to branches, leaving half of the tree hanging on one side of the cleft and half on the other. A remarkable earthquake in 1886 was the one in Charleston, South Carolina, the shock of which was felt from the Gulf of Mexico to the great lakes, and from the Atlantic to the Mississippi River. The natural phenomena connected with the Charleston earthquake were curious fissures opened, often of great length, sulphurous fumes emitted, sand, red and white, thrown up, and brackish, tepid water spouted out.

In January, of last year, an unusually violent earthquake near Tokio, in Japan, was felt over 32,000 square miles.

One of the most remarkable volcanic eruptions known in the history of the world occurred in 1883, in the volcanic island of Krakatau, in the Strait of Sunda, which separates the island of Sumatra from Java. The volcano was supposed to be extinct, but on the 20th of May an eruption began, which lasted several days. A white column of vapor, enclosing dark clouds, rose to the great height of 36,000 feet. The eruption continued from the 22d to the 23d of May, and from the 25th to the 28th of August following; the latter being the most severe. The disturbance was accompanied by great tidal waves, which, at Merak, rose to a height of 90 feet, and swept the whole coast up to the hills. In Merak only one person was left alive. There were

three tidal waves, the last carrying off all that was left by the two preceding. The devastation was terrible, both on the Sumatra and the Java sides of the strait. Whole villages were destroyed ; explosion followed explosion, with a rain of ashes continually. The distance at which the noise of the eruption was heard surpasses anything previously known. The report was heard in every island of the Archipelago, including the Philippines. Taking the volcano as a centre, the sounds were propagated in a circle, having a diameter of 4142 miles, and the area enclosed within this circle was equal to one-fifteenth of the earth's surface. The very fine ashes carried up into the air changed the appearance of the sun as seen at Japan, in places on the Mediterranean and on the Pacific Ocean. The ocean wave extended 6685 nautical miles, and what is most remarkable, there was not the least mark of upheaval discovered either at the bottom of the sea or on the coast.

ASIA.

The Russian scientist, Konschin, made a journey east of the Caspian and north-east of Turkistan, embracing the Kara Koom desert and the Attak oasis, a region of vast sands and salt deserts. The Kara Koom desert, he thought, was a part of the old Aral basin in which he saw evidence of great geological change. He found that the Kara Koom desert retained traces of marine fauna. The eastern part of it, which consists of dried-up lakes, is the oldest, and has a line of hills that mark the ancient shores of the Caspian Sea. The conversion of the desert into sand, he thought, was owing to upheaval and the polar winds.

Bonvalot and Capus, the French travellers, passed two years in exploring the region of the river Oxus. They descended the Oxus and found ruins of towns dating back to the time when the river flowed into the Caspian Sea.

OXUS.

A bridge over this river near Charjui, more than two miles in length, has recently been constructed, and two Russian steamers have been launched upon the historic river and now run regularly upon it. The erection of this bridge over the Oxus and the completion of the railroad to Samarcand will no doubt be followed on the part of the Russians by the annexation of Bokhara, and Russian dominion will thus be secured from the base of the Caspian to this important part of Turkistan.

The Russian traveller, Sevastof, examined the famous region of the Pamir. He says it is not a table-land, and that it has no steppes up to 12,000 feet. The valleys are about 13 miles wide, and the mountains are 7000 feet above the valleys. Three of the mountains rise to a height of 25,000 feet.

Prejevalsky, the Russian explorer, whose previous geographical labors in this part of Asia I have frequently mentioned, crossed the Gobi desert to Alachan, in Mongolia, and so into Northern Thibet, where he found men working in gold mines, and he thought this part of Thibet richer in gold than California. He reached the Koko Nor lake, which is 15,700 feet above the level of the sea, and is 170 miles in circumference. He found it frozen at the end of April. West of the lake was a great salt marsh, 500 miles long and 70 miles wide, and on the plateau upheld by the great mountain,

which was over 17,000 feet high, he found the sources of the celebrated Chinese rivers, the Hoang-Ho and the Yang-tze-Kiang. He reached the source of the Hoang-Ho, which he found to be 13,600 feet high, and the water-shed between the two rivers was 1000 feet high. The climate was terrible at the end of May. The region is wild and forbidding, so that the nomadic tribes will not stay, and yet it abounds in wild animals.

The well-known Russian traveller, Potanin, in 1883 and 1884, with Skassy and Berezovski, accompanied by Madame Potanin, who rendered valuable aid, made a journey of exploration in China and Mongolia, starting from Peking. To give an account of this journey would require the constant mention of Chinese names which would not indicate the journey, without a much fuller map than it is possible to display upon this platform. It must suffice, therefore, to say that it was over great plains and high plateaux, following up and crossing labyrinths of steep mountains cut in nearly every direction by narrow valleys, which are the sources of great rivers. On the plain of Ordos, in Mongolia, which is bounded on three sides by the bending of the Hoang-Ho, or Yellow River, and on the fourth by the mountains that divide the plain from China proper, they saw a felt tent, in which, it was said, were kept the bones of Genghis Khan, who died here. Legends respecting him abounded everywhere about. It was believed that his body was enclosed in a silver coffin with an outer case of wood, under a canopy of silk. Members of his family lie buried around him for a distance of 3 miles. It is believed that every evening a sheep and a horse are offered up to the spirit of the great Asiatic conqueror,

or, as he is called, "The Supreme Sovereign." The people declare that the voices of the Chinese he had slain are heard around at night, with other sounds and sights, as Milton expresses it,

" — airy shapes that syllable men's names
In sands and wastes and desert wildernesses."

It is a tradition that the long sand dunes which exist there were thrown up as ramparts by Genghis to turn the course of the Yellow River. Wild as the region was, they found the remains of great cities, one of which, 20 miles south of the Hoang-Ho, had walls that measured nearly 5 miles on a side. At Lan Chu they found the country one vast garden. Here they separated, and Potanin went up the Hoang-Ho to its sources.

A pundit, A——k, of the Indian Survey, made a four years' journey through Great Thibet to the north and east over a vast region almost wholly unknown. With a rosary to count his paces, a prayer-book, and speaking Thibetan, he crossed the Himalayas, entering Thibet, and found his way to Lassa, where he was detained a year; but where, however, he was not idle, for he made a survey of this celebrated but little-known city, the Rome of Thibet, which is crowded with temples and religious edifices.

After this he went with a caravan north-easterly to Mongolia, crossing the great plain of Thibet, called Chang Tong, or the Northern Plain. Over this plain he passed a cultivated country, with fixed habitations; then a pastoral land of 180 miles of wandering encampments, where he counted over 7000 tents. The remaining 240 miles of Chang Tong he found uninhabited, and

abandoned to wild animals. The highest pass crossed was the Donga range, 16,400 feet, which is the water parting between the Yang-tze-Kiang and the Mekong of Cambodia. He descended to a level of 9000 feet, where he found a comparatively warm region, with abundant forests and cultivation, thus reaching the border-land between Thibet and China. He passed through Lithang, one of the highest cities of the world, at an altitude of over 13,000 feet, (about the height of Potosi, in Bolivia, which is 13,649,) and which, though at the very extremity of respirable atmosphere, had at one time a population of 150,000. He found that the Sangpo River merges into the Bramapootra, as Colonel Yule and other geographers have maintained, and in November, 1882, he completed the arduous journey of 2,800 miles through a nearly unknown country. He succeeded in keeping up an unbroken route survey, with magnetic bearings, bringing back with him all his field-books, after exploring regions which Englishmen, Russians and Hungarians have heretofore attempted in vain.

THE HOANG-HO.

A remarkable event occurred during the present year in North-eastern China. The Hoang-Ho, or Yellow River, is one of the great rivers of the world, and also one of the most devious, running over its long course of 2700 miles in every direction, north, south, east, and west. It is also the most turbulent and impetuous of rivers, sometimes changing its bed and finding a new mouth far from the former one, and at others expanding into vast and destructive floods. Its source has recently been accurately ascertained, as I have said, by Mr. Pota-

nin, who found that it rises in the Amdo plateau of North-eastern Thibet. Previous to 1853 the river descended from the north and ran almost directly south for about 500 miles, where it made a bend, and entering the great plain of Northern China ran almost due east for about 650 miles to the Yellow Sea, where it formed a large mouth or estuary. In 1853, in the mountainous region where the river takes its rise, at an elevation of nearly 12,000 feet, the accumulation of snow was so great, and the melting of it so rapid, as to largely swell the volume of water in the river, which, augmented by the autumnal rains, became so powerful that beyond the great bend, near Kai-fung-Fu, where the country is low and flat, the river burst its northern bank, and, passing through the opening thus made, found its way in a north-easterly direction to the Gulf of Pechili, 500 miles from its former mouth.

This catastrophe was attended by wide-spread destruction, for the country through which the river rushed in its new course was one of the most fertile and thickly populated in China. The destruction of property and of human life was very great; and now, after 35 years, and after the country thus devastated had recovered from the disaster that befell it, the accursed river, as the Chinese call it, burst through its southern bank near Kai-fung-Fu, which is a little above the place where the former disaster occurred; the volume and force of the water being so great as to make an opening or gap four miles wide, where a moving mass of water, 12 feet high, rushed through, and, spreading in every direction, brought ruin and desolation over what had been before a most fertile and highly cultivated country.

The disaster has been so recent that we do not yet know its full effect ; whether from the nature of the country the waters have formed a huge lake into which the river will hereafter run, as the Volga into the Caspian, or the Oxus into the Sea of Aral, or whether, following a channel or bed, they may, as before, find their way as a continuous river to the Yellow Sea. As the country is low and flat, the latter result appears the more probable.

It has been said that the Chinese dread this river more than war, pestilence, and famine. One of their emperors declared that looking after it gave him more anxiety than the government of the whole kingdom. Their records show that during the past 2500 years the river, below Kai-fung-Fu, the scene of the present disaster, has changed its course and found a new mouth no less than nine times. The geographical phenomenon of rivers changing their beds and forming new outlets has taken place in other countries, especially in Spain ; but nothing on a scale of such magnitude as the changes of the Hoang-Ho has occurred in the past history of the world.

In 1883 Mr. Colquhoun, at the head of the Wahab Expedition, made a journey from Canton through the province of Yunnan, in China, the most broken and mountainous peopled country in the world, and thence across China to Bhamo, in Northern Burmah. It was a most difficult and exhausting journey, over roads terribly bad, food being poor and scarce, except in the towns; the inns miserable. Along the route they found traces of the great rebellion in very numerous ruined villages, and other evidences of a past prosperity. Two

thousand miles of the route were surveyed, embracing the whole of Southern Yunnan, along a route of great importance, hitherto untrodden except by the Chinese. Their way was very much obstructed by officials and others, but the aboriginal people were found kind and hospitable.

M. D'Angis ascended the Hai-Ho, or Black River, in an attempt to reach Yunnan in South-west China, and the river was found to be impeded by 54 rapids.

Mr. Boulangier made a journey in Siam and Cambodia. He found that Upper Cambodia was a fertile country, and that Lower Cambodia was under water during four months of the year, so that the raising of rice is alone profitable.

The occupation of Cochin China by the French has resulted in a material change in the political geography of this part of South-eastern Asia. They extended a protectorate over Annam, the long and narrow country lying between Siam, the Shan States, and the ocean, and afterwards conquered Tonquin, lying between Annam and China, with the declared object of finding a commercial entrance into the rich Chinese province of Yunnan, by water, along the Song-tai River, which runs through Tonquin to the Gulf of Tonquin, in the China Sea, and they have now extended a protectorate over Cambodia, with a design of forming a French Indo-Chinese Empire. The character of the people of Annam and Tonquin, already debased by vices and bad habits, has not been improved by their contact with the French.

BABYLONIAN RECORDS.

Before mentioning the travels and explorations of M.

and Madame Dieulafoy in Northern Persia, which have an interest alike geographical and archæological, and with which I shall close my address, I may mention that the explorations upon the sites of Nineveh and Babylon have brought to light information showing that many things supposed to have come into use after the Middle Ages are of remote antiquity. M. Revillout, from the study of the clay tablets, or bricks, as they are called, has found that the Chaldeans had banks where the depositor could open a credit, drawing upon what he had in the bank, as in modern times, by a check. He could either open a credit with a bank, or deposit his capital there for security. Mortgages were extensively in use among the Babylonians, drawing an annual rate of interest. Guardians were appointed for minors or married women, whose parents were dead. Prisoners were released from confinement upon giving bail, that is, upon their friends giving security for their appearance, and associations were formed for the carrying on of a business either as partnerships, or somewhat in the nature of our modern corporations. Truly it may be said with Solomon, there is nothing new under the sun.

PERSIA.

The French Minister of Public Instruction sent M. and Madame Dieulafoy, with Babin and Houssay, to make excavations at Susa, the Biblical Shushan, the Palace, as it is called in Scripture, and to secure for the museum of the Louvre what antiquities might be found. Mme. Dieulafoy, who went with the expedition, displayed a courage, zeal and energy so extraordinary that the Government made a special recognition of her services.

The collections made for the museum weighed in all something like 60 tons, and these had to be transported from Susa to Bassora, a distance of 250 miles across a desert country.

With this expedition to Persia, one of the early seats of human civilization, I may appropriately bring to a close this account of the recent geographical work of the world.

U. S. COAST AND GEODETIC SURVEY.*

Among the contributions of value made to geographical knowledge in the progress of the work of the Coast and Geodetic Survey up to the close of the past year may be enumerated the following :

Upon the Atlantic and Gulf coasts the triangulation intended to define accurately the coast line, and to determine in geographical position all important harbors, landmarks and aids to commerce and navigation has been nearly completed. Short gaps remain to be filled upon the coasts of North Carolina, Alabama and Louisiana, and work upon two of these is now in progress. Triangulation of outer coast line is entirely completed from Maine to Texas, except two or three bases of verification being measured the present winter. The points referred to in North Carolina, Alabama and Louisiana are simply bays and harbors. As soon as appropriations become available, certain connections of the main triangulation along the Appalachian chain with the coast triangulation must be made, and the triangulations on the east and west coasts of the peninsula of Florida must be united on a line from Fernandina to Cedar Keys. For the purposes of geodesy it will be of interest to know that an oblique arc of the meridian, carried by the primary triangulation from Calais, Maine, to Atlanta, Georgia, a distance of some 1,200 statute miles, has been completed nearly to Montgomery, Alabama, and that operations are now in hand for extending this arc to the Gulf Coast at Mobile, thus securing the measurement of an oblique arc of twenty-two degrees.

Upon the Pacific coast the triangulation has covered all of the more important harbors and anchorages between San Diego and the Gulf of Georgia, and has made progress in South-eastern Alaska.

The topography, which by the organic law of the survey is executed for purposes of commerce and defence, has followed closely and nearly kept pace with the advance of the triangulation upon the Atlantic and Gulf coasts. Excepting the topography of rivers to the head of ship navigation, it may be said to be practically continuous on these coasts from Passamaquoddy Bay to the Rio Grande, the only gaps remaining to be filled being at the north-eastern extremity of the coast of Maine ; on the west coast of Florida, between Cape Sable and Cape Romano ; at

* For these notes I am indebted to the kindness and courtesy of F. M. Thorn, Esq., the Superintendent of the United States Coast and Geodetic Survey. C. P. D.

Perdido Bay ; at Atchafalaya River and Grand Bay, and on the coast of Texas, between Sabine Pass and Vermilion Bay.

In all of the more important localities on the Pacific coast the topography has been finished. On the coast of California it has been completed from San Diego to Trinidad Head, with the exception of two gaps. On the coast of Oregon a number of gaps are yet to be filled, mainly of stretches of coast where no harbors exist. The topographical surveys in Alaska have been of a preliminary nature.

In the interior States no opportunity has been lost of extending the determinations of geographical position under the law providing for a geodetic connection between the Atlantic and Pacific coasts. This connection, which is being carried across the continent by a belt of primary triangulation near the 39° parallel, is now about two-thirds completed. The elevated peaks of the Coast Range and of the Sierra Nevada, in California and Nevada, and those of the Rocky Mountains in Utah, have helped to carry long lines of primary triangulation, advancing eastward to connect with similar triangulation proceeding westward from the Atlantic coast. Recent primary triangulation in Utah has developed, as a part of this scheme, four lines ranging in length from 140 to 150 miles, between mountain peaks ranging in elevation from 11,800 to 13,100 feet. The advance of this triangulation, with the continuation and extension of that in the several States which have made provisions for their own topographical and geological surveys, is gradually providing a basis upon which the States interested can make trustworthy State maps.

Not a few inquiries of scientific value have light thrown upon them in the course of the occupation of elevated mountain peaks for geodetic work ; among these there is the effect of mountain masses upon the direction of the vertical. Special attention was given to this subject in the course of the year by an officer of the Survey detailed for duty with the Hawaiian Government Survey, at the expense of the latter. Determinations of latitude and gravity upon the Hawaiian Islands were made under conditions exceptionally favorable for observing changes in the direction of the vertical dependent upon the great depth of the sea, the volcanic formation of the mountains, and their distance from the masses of the continent. At Kahuku, on the windward side of Oahu, preliminary reductions have shown a difference between the astronomical and geodetic latitudes of nearly a minute of arc, one of the most striking examples in the world of deflection of the plumb-line from mountain attraction.

The hydrographic work of the Survey is now practically complete upon the Atlantic and Gulf coasts ; the only gaps remaining to be filled being in Cobscook Bay, Maine ; off the west coast of Florida, and on the Gulf coast west of the Passes of the Mississippi. Upon the Pacific coast all of the chief harbors, anchorages and roadsteads, with their approaches, have had their hydrography finished ; the stretches of coast that yet remain are those where the interests of commerce and navigation are of least importance. But the effort is to finish these also as soon as practicable. Hydrographic work in South-eastern Alaska has been pushed with great energy ; during the past year an area of 1,600 square miles was covered, and over 17,500 miles of soundings were run by the combined parties, the localities being Clarence and Sumner and Wrangell Straits.

In the domain of physical hydrography the most notable researches were those which led to the announcement of the laws of the circulation of the sea through New York Harbor (Appendix No. 13, 1886) and the observations of currents in the Gulf Stream, carried on with apparatus specially devised for the purpose and perfected by trial during several seasons of Gulf Stream exploration. (Appendices 14, 1885; 11, 1886, and 8, 1887.) During the past season observations of currents were made upon lines crossing the Stream, or normal to its course, between Rebecca Shoal and Cuba; between Cape San Antonio, Cuba, and Yucatan, and from Cape Hatteras Shoal south-east, currents being observed at a number of stations on these lines at much greater depth than ever before attempted, the steamer being safely anchored at each station. The greatest depth of anchorage was in 1,852 fathoms, off Cape Hatteras, and that, too, with a surface current of over four knots.

It is anticipated that one result of these investigations, if the means afforded of prosecuting them are continued, will be to ascertain the effect of the tides upon the currents of the Gulf Stream, and supply the mariner with tables predicting these effects and the amount of daily variation in the current, its depth and velocity at different depths. A notice to mariners embodying such predictions has, in fact, already been issued from the Coast Survey Office, which now issues a monthly notice to mariners, covering all dangers, changes, etc., developed since the last previous notice. The Survey is now issuing, gratuitously, Index maps and a graphic catalogue of its charts.

Besides its work on the primary survey, the Bureau continues, whenever needed, re-surveys of harbors and bays, and, incidentally to its main work, it has aided the States of Connecticut, New York, Maryland, Virginia, and North Carolina in the development of the area and availability of their oyster grounds. It has aided in rectifying the boundaries of several States. It has published charts of the magnetic declination, dip and intensity throughout the United States. Appendices 12 and 13, Report of 1882, contain data indicating variation of the needle anywhere in the United States during the last century, or for a quarter of a century to come.